ABSTRACT

TITLE:	The Testing and Feasibility of Piezoelectric-Excited Millimeter-Sized Cantilevers to Detect Pathogenic Strains of Escherichia Coli in Third World Water Sources
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ABSTRACT: With contaminated water supplies being one of the world's greatest sources of preventable waterborne illnesses, this project's scope is focused on the construction, testing, and analysis of several piezoelectric-excited millimeter-sized cantilever (PEMC) biosensors. The cantilevers will be constructed by attaching lead zirconate titanate (PZT) sheets to glass plates such that the glass acts as a vibrating attachment zone for pathogenic cells. The biosensor is thus essentially a resonant microelectromechanical system (MEMS). This approach allows for measurements of mass to be taken utilizing two phenomena, resonant frequency dependency on mass and the piezoelectric phenomena. Using a simple frequency generator to stimulate the PZT transducer, the resonant frequency of a cantilever can be determined by a series of voltage measurements to model impedance of the system. These impedance models have a certain quality (Q) which is determined by geometric and material constraints of the sensor. For testing the biosensor, the immobilization of Escherichia coli O157:H7 species specific monoclonal anti-bodies (MAb) to the glass will be conducted using techniques described the literature. This will allow for the mass of the cantilever to rise when in the presence of O157:H7 E. coli cells. Then finally, using a cell counting device, control samples of heat killed O157:H7 cells will created such that calibration and accuracy of the biosensor can be measured. The feasibility of a Piezoelectric-excited millimeter-sized cantilever (PEMC) to detect pathogen Escherichia coli (E. coli) O157:H7 in water sources will be analyzed under constraints brought forth from the Engineers Without Borders organization. The design and research will include an analysis of durability, accuracy, maintenance, theoretical modeling of cell attachment to the cantilever, and cost for a "biosensor package".